# SITE-SPECIFIC PROBABILISTIC SEISMIC HAZARD MAPS OF NEW ZEALAND FOR 475 YEAR AND 2,475 YEAR RETURN PERIOD

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## 1. INTRODUCTION

The latest two great earthquake sequences; 2010-2011 Canterbury Earthquake and 2016 Kaikoura Earthquake, necessitate a better understanding of the New Zealand seismic hazard condition for new building design and detailed assessment of existing buildings.

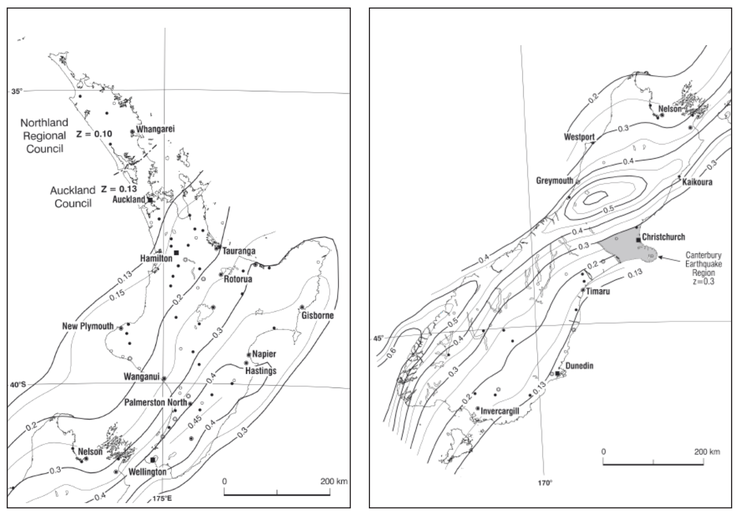


Figure 1: Hazard Factor, Z from NZS 1170.5:2004

It is important to note, however, that the New Zealand seismic hazard map in NZS 1170.5.2004 is generalised in effort to cover all of New Zealand and limited to a earthquake database prior to 2001. This is “common” that site-specific studies typically provide spectral accelerations different to those shown on the national map (Z values in NZS 1170.5:2004); and sometimes even lower. Moreover, Section 5.2 of Module 1 of the Earthquake Geotechnical Engineering Practice series provide the guidelines to perform site-specific studies.

## 2. PSHA AND SEISMOTECHTONIC MODEL

The Probabilistic Seismic Hazard Analysis (PSHA) method was developed by Cornell (1968). In general PSHA can be expressed in the following formula:

$$H(a) = \sum v_i \iint P[A > a \mid m, r]\, f_{Mi}(m)\, f_{Ri|Mi}(r,m)\, dr\, dm$$

1. Active faults and area seismic sources from the 2010 NZNS
2. Time-dependent model for Canterbury based on Oomorai Law

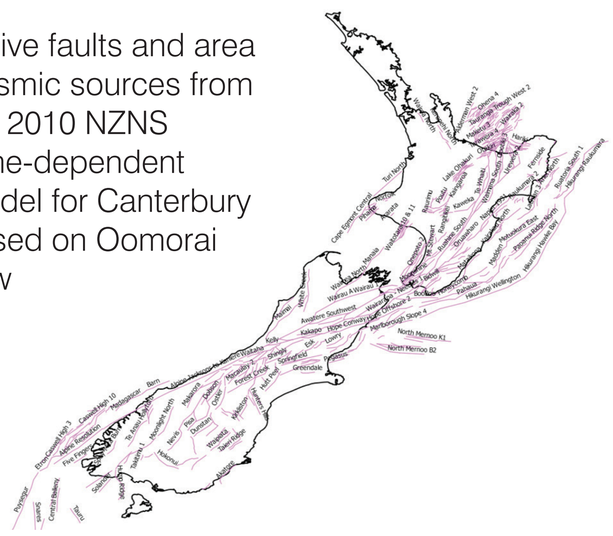

Figure 2: Fault database used in analyses

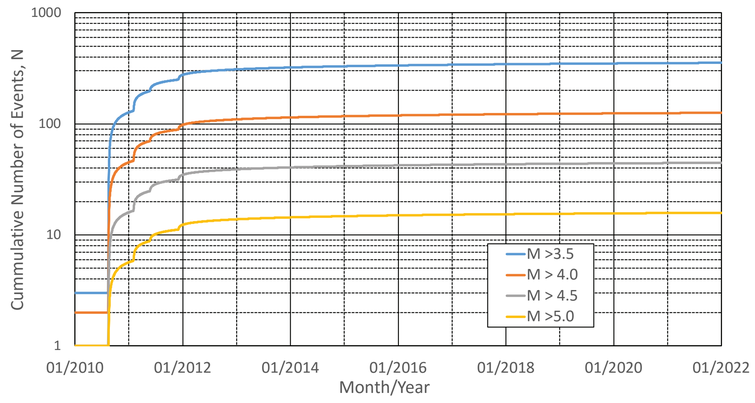


Figure 3: Predicted rate of aftershocks in Canterbury region based on Oomori Law (up to 2020)

## 3. GMPE AND LOGIC TREE

Two well-known site-specific ground motion prediction equations (GMPE) for New Zealand were selected for this study:

1. Bradley (2013)
2. McVerry et al. (2006)

Logic trees were used to account epistemic uncertainty including maximum magnitude and two GMPEs.

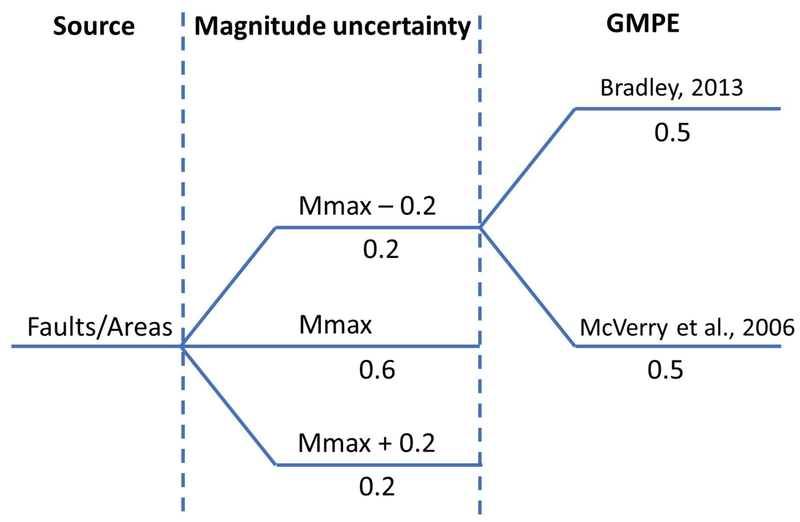


Figure 4: Logic tree used in the analyes

## 4. RESULTS

Figure 5 presents the peak ground acceleration (PGA) contour for Site Class C (Vs30 = 500 m/s). The PGA contours represent for 10% probability of exceedance (PE) in 50 years (475 years earthquake) and 2% PE in 50 years (2,475 years earthquake) at ˜67,000 sites in an area between 166°E to 179°E and 34°S and 48°S.

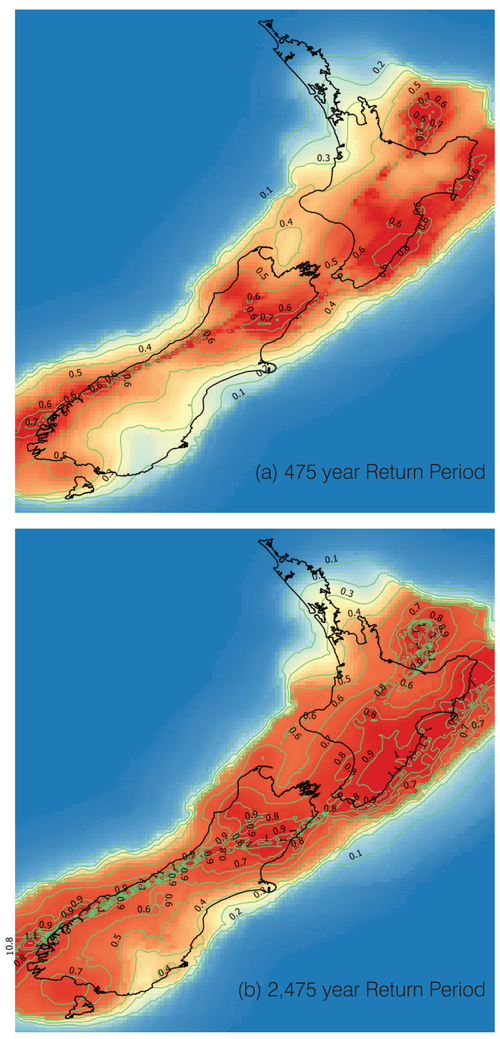


Figure 5: Map of Peak Ground Acceleration (PGA) for 10% and 2% Probability of Exceedance in 50 years (475 year and 2,475 year Return Period)

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